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ON THE EXISTENCE OF A DIFFUSION BARRIER BETWEEN  
THE TROPOSPHERES OF THE SOUTHERN  
AND NORTHERN HEMISPHERES

by

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by Jacques Labeyrie  
and Gérard Lambert

SUMMARY

The study of the concentration of radioactive artificial aerosols in the lower atmosphere as a function of latitude shows the existence of a permanent barrier between the Northern and Southern Hemispheres' tropospheres.

\* \* \*

1. The importance of updrafts existing in the equatorial regions suggests that the meridian tropospheric circulation must be very limited at low latitudes, which is easy to notice through a systematic study of the direction and velocity of winds near the equator. However, nothing permitted until these last years to appreciate the weakness of the various transfer mechanisms between the tropospheres of both hemispheres.

The injection into the various atmosphere layers of large amounts of various products of fission following nuclear explosions has supplied in the form of artificial radioactive aerosols a tracer, easily collectible by filtration of the air on cellulose filter. Then the radioactivity  $P$  of these filters is measured after a delay permitting the elimination of contributions from natural radioactivity. The amount of aerosols injected in the Northern hemisphere is much greater than that injected in the Southern hemi-

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\* Sur l'existence d'une barrière de diffusion entre les troposphères des hémisphères Nord et Sud.

sphere, and this should allow a quantitative study of transfers between these two hemispheres.

The very heterogeneous distribution near the ground, as a function of latitude was already noted, namely by Lockhart, thanks to a network of stations aligned along the 80° meridian of Western longitude, and by Picciotto, following measurements made aboard a ship (see respectively refs. [1] and [2] ).

2. In order to observe quantitatively the transfer between the two hemispheres, we established a triple network of stations for the collection of aerosols in the atmosphere;

1) aboard ships carrying supplies to French expeditions in the Antarctica [3, 4, 5];

2) at various stations located in France, Algeria, Sahara, and also in Dakar, Pointe Noire, Nouméa, Port-aux Français (Kerguelen islands), the Dumont d'Urville base (Terre Adélie), where identical installations allowed the control of the results obtained aboard ships, and to follow the evolution in time and in situ of the artificial  $\beta$ -radiation of the atmosphere [6];

3) a network of 60 radioactive fallout collectors, spread between 50° Northern latitude and 65° Southern latitude, allowed us to measure the importance of atmosphere cleaning.

3. The results obtained were as follows:

1) In the absence of recent explosions the concentration of active aerosols at sea level varies sensibly with the latitude. The curves obtained for November 1960 and February 1961 (Fig.1) show the existence at low latitudes of a clearly outlined minimum, also observable on the curve relative to radioactive fallouts per unit of surface. This excludes the possibility of explaining this minimum by a more intensive lixiviation of the atmosphere under an equatorial climate.

These results are explained, if one admits that the injection of products of fission into the troposphere, starting from a stratosphere reservoir, takes preferably place at middle latitudes, and that the aerosols thus injected do not reach the equatorial regions. In any case, the pattern of distributions observed rules out the idea of low-altitude diffusion from the Northern to the Southern hemisphere.

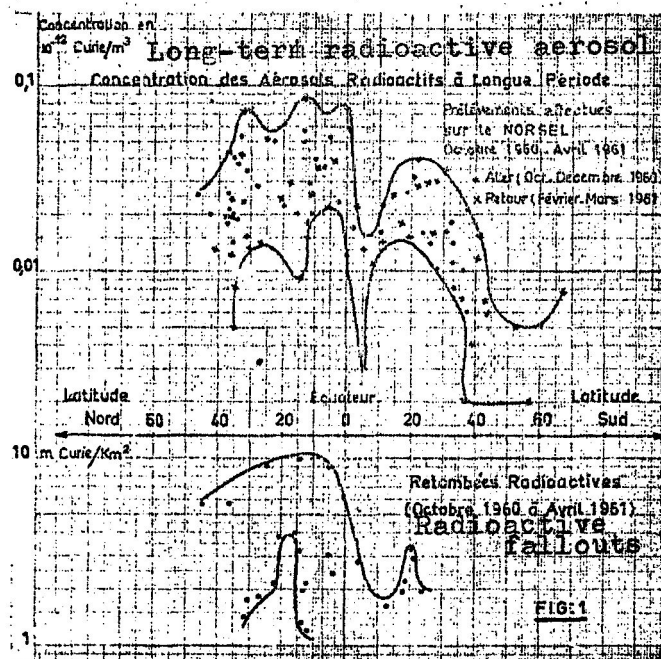
2) The artificial radioactive aerosols introduced into the troposphere during the explosions of February 1960 and from September to November 1961, failed to penetrate into the Southern hemisphere as is shown in Fig. 2 and 3, whose results are corroborated by those of fixed stations. In Fig. 3 we may notice that the profile is in the whole Southern hemisphere exactly similar to that obtained the preceding year, and indicated in Fig. 1.

3) The measurements carried out after the nuclear explosions of May 1962 at Christmas Islands ( $2^{\circ}$  No. lat.) disclose that the debris of these explosions, visible in the stratosphere of the Northern hemisphere, do not appear at the troposphere of the same latitudes [7]. Measurements pursued in the Southern hemisphere allow to the contrary the detection of these products at low altitudes.

#### 4. CONCLUSIONS.

Notwithstanding the fragmentary aspect of the profiles plotted, the whole of these results allows to conclude on the existence in the equatorial troposphere of a true permanent barrier, that opposes any air mass transfer from one hemisphere to the other at low altitude. Communications at the stratosphere level are the only possible ones. Scarce passages of air through that barrier would have an exceptional character, and quite negligible from the quantitative point of view.

\*\*\* THE END \*\*\*



concentr.

Sampling made o/b SS Norsel

Fig. 1

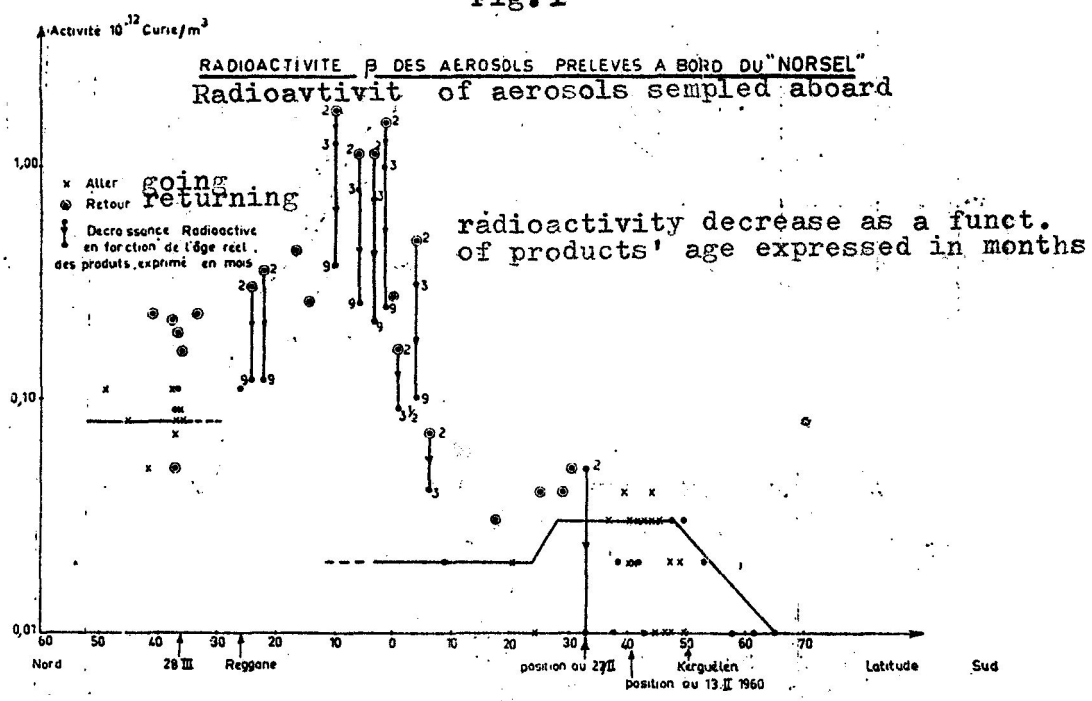


Fig. 2.

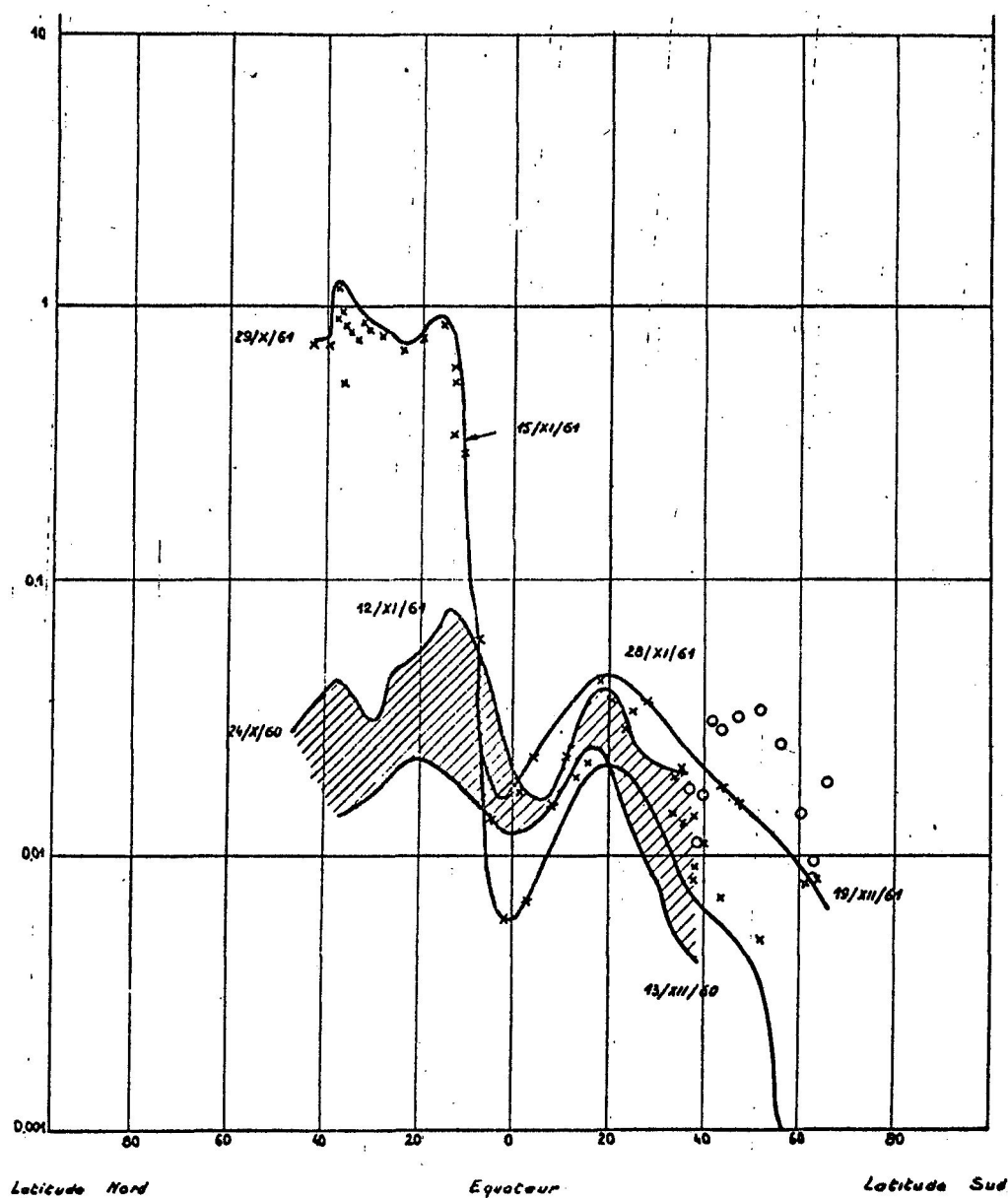


Fig. 3.

 $10^{-12} \text{ Ci/m}^3$ .

//// curve obtained in October-December 1960

x curve obtained at outbound trip, 1961, measured Jan. 1962

o Return trip (Feb. 1961, measured in June 1962)

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